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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/053,085	11/09/2001	Raymond J. Gorte	PENN.N2437 C	5527

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EXAMINER	
YUAN, DAH WEI D	

ART UNIT	PAPER NUMBER
1745	

DATE MAILED: 11/03/2003

14

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/053,085	GORTE ET AL.	
	Examiner	Art Unit	
	Dah-Wei D. Yuan	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 September 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-53* is/are pending in the application.

4a) Of the above claim(s) *31-53* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a)☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1)☐ Notice of References Cited (PTO-892)
2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3)☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *12* .
4)☐ Interview Summary (PTO-413) Paper No(s). _____ .
5)☐ Notice of Informal Patent Application (PTO-152)
6)☐ Other: .

THE USE OF SULFUR-CONTAINING FUELS FOR DIRECT OXIDATION FUEL CELLS

Examiner: Yuan S.N. 10/053,085 Art Unit: 1745 October 31, 2003

Detailed Action

1. The Applicant's request for reconsideration filed on September 17, 2003 was received.

2. The text of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action (Paper No. 11).

Claim Rejections - 35 USC § 103

3. The claim rejections under 35 U.S.C.103(a) as being unpatentable over Wallin and Anumakonda et al. on claims 1-6,9-27,30 are maintained. The rejection is repeated below for convenience.

With respect to claim 1, Wallin teaches a solid oxide fuel cell comprising a electrolyte membrane of a ceramic oxygen ion conductor, a porous anode in contact with the electrolyte membrane on the fuel side of the cell, and a porous cathode in contact the electrolyte membrane on the oxidant side of the cell. The anode is typically a ceramic-metal composite. The net electrochemical reaction involves charge transfer steps that occur at the interface between the ionically conductive electrolyte membrane, the electronically-conductive electrode and the vapor phase. The vapor phase involves fuel for the anode and oxygen for the cathode. See Column 1, Lines 30-42.

However, Wallin does not disclose the characteristics of the fuel used for the aforementioned solid oxide fuel cell. Anumakonda et al. teach the use of sulfur-containing heavy hydrocarbon fuels for a solid oxide fuel cell. The hydrocarbon fuel is a liquid hydrocarbon having at least six carbon atoms and a sulfur content of at least 50 ppm. In one embodiment, the JP-8 fuel has a sulfur content of about 3000 ppm. The feed, containing the vaporized fuel and oxygen, is partially oxidized by a catalytic reaction to convert the hydrocarbon to hydrogen and carbon monoxide. As a result, the use of catalytic partial oxidation process to produce fuel enables a simplified overall system design. See Abstract, Column 1, Lines 11-15; Column 4, Lines 7-9,35-39. Therefore, it would have been obvious to one of ordinary skill in the art to use a fuel having sulfur content of at least 50 ppm to about 3000 ppm on the solid oxide fuel cell of Wallin, because Anumakonda et al. teach the processing and use of a sulfur-containing hydrocarbon fuel, such as JP-8, to simplify the overall design of a fuel cell system.

With respect to claims 2-6,9, Anumakonda et al. teach the conversion of refinery liquid hydrocarbon fuels, such as gasoline and naphtha, to hydrogen/carbon monoxide gas streams by partial oxidation process. The hydrocarbon fuels further comprises fuels, such as JP-4 jet fuel, JP-5 jet fuel, JP-8 jet fuel, No. 2 fuel oil, diesel oil, kerosene, and decane. See Column 2, Lines 6-18; Column 5, Lines 39-43; column 13, Lines 15-28. Therefore, it would have been obvious to one of ordinary skill in the art to use fuel, including jet fuel, gasoline, naphtha, fuel oil, diesel oil, kerosene, and decane, on the solid oxide fuel cell of Wallin, because Anumakonda et al. teach

the processing and use of a sulfur-containing hydrocarbon fuel can simplify the overall design of a fuel cell system.

With respect to claims 10-14, Anumakonda et al. teach the military specification for maximum sulfur content in logistic fuels, such as Jet A, JP-4, JP-5, and JP-8, is 0.3 wt% (3000 ppm). Typically, however, commercially available jet fuels have a total sulfur content of about 0.05-0.07 wt.% (500-700 ppm). See Column 2, Lines 38-44. Therefore, it would have been obvious to one of ordinary skill in the art to use a fuel having sulfur content of at about 500 to about 700 ppm on the solid oxide fuel cell of Wallin, because Anumakonda et al. teach the processing and use of a sulfur-containing hydrocarbon fuel, such as JP-4, JP-5, and JP-8, can simplify the overall design of a fuel cell system.

With respect to claim 15, Wallin discloses the electrolyte membrane is a ceramic oxygen ion conductor. See Column 1, Lines 30-32.

With respect to claims 16-19, Wallin teaches suitable ionically conductive materials include doped zirconia such as yttria-stabilized zirconia, scandium-doped zirconia, gadolinium-doped ceria, and rare earth or alkaline earth-doped $LaAGaO_3$. See Column 4, lines 49-59.

With respect to claim 20, Wallin teaches process to generate electrical energy by using a solid oxide fuel cell, which comprises a electrolyte membrane of a ceramic oxygen ion conductor, a porous anode in contact with the electrolyte membrane on the fuel side of the cell, and a porous cathode in contact the electrolyte membrane on the oxidant side of the cell. The anode is typically a ceramic-metal composite. The net electrochemical reaction involves charge transfer steps that occur at the interface between the ionically conductive electrolyte membrane,

the electronically-conductive electrode and the vapor phase. The vapor phase involves fuel for the anode and oxygen for the cathode. See Column 1, Lines 30-42.

However, Wallin does not disclose the characteristics of the fuel used for the aforementioned solid oxide fuel cell. Anumakonda et al. teach the use of sulfur-containing heavy hydrocarbon fuels for a solid oxide fuel cell. The hydrocarbon fuel is a liquid hydrocarbon having at least six carbon atoms and a sulfur content of at least 50 ppm. In one embodiment, the JP-8 fuel has a sulfur content of about 3000 ppm. The feed, containing the vaporized fuel and oxygen, is partially oxidized by a catalytic reaction to convert the hydrocarbon to hydrogen and carbon monoxide. As a result, the use of catalytic partial oxidation process to produce fuel enables a simplified overall system design. See Abstract, Column 1, Lines 11-15; Column 4, Lines 7-9,35-39. Therefore, it would have been obvious to one of ordinary skill in the art to use a fuel having sulfur content of at least 50 ppm to about 3000 ppm on the process of Wallin, because Anumakonda et al. teach the processing and use of a sulfur-containing hydrocarbon fuel, such as JP-8, can simplify the overall design of a fuel cell system.

With respect to claims 21-27, Anumakonda et al. teach the conversion of refinery liquid hydrocarbon fuels, such as gasoline and naphtha, to hydrogen/carbon monoxide gas streams by partial oxidation process. The hydrocarbon fuels further comprises fuels, such as JP-4 jet fuel, JP-5 jet fuel, JP-8 jet fuel, No. 2 fuel oil, diesel oil, kerosene and decane. See Column 2, Lines 6-18; Column 9, Lines 1-4; column 13, Lines 15-28. Therefore, it would have been obvious to one of ordinary skill in the art to use fuel, including jet fuel, gasoline, naphtha, fuel oil, diesel oil, kerosene and decane, on the process of Wallin, because Anumakonda et al. teach the processing

and use of a sulfur-containing hydrocarbon fuel can simplify the overall design of a fuel cell system.

With respect to claim 30, Anumakonda et al. teach the military specification for maximum sulfur content in logistic fuels, such as Jet A, JP-4, JP-5, and JP-8, is 0.3 wt% (3000 ppm). Typically, however, commercially available jet fuels have a total sulfur content of about 0.05-0.07 wt.% (500-700 ppm). See Column 2, Lines 38-44. Therefore, it would have been obvious to one of ordinary skill in the art to use a fuel having sulfur content of at about 500 to about 700 ppm on the process of Wallin, because Anumakonda et al. teach the processing and use of a sulfur-containing hydrocarbon fuel, such as JP-4, JP-5, and JP-8, can simplify the overall design of a fuel cell system.

4. The claim rejections under 35 U.S.C. 103(a) as unpatentable over Wallin and Fasano et al. as evidenced by Yamauchi et al. on claims 1,2,7,8,20,28,29 are maintained. The rejection is repeated below for convenience.

With respect to claims 1,2,7,8, Wallin teaches a solid oxide fuel cell comprising a electrolyte membrane of a ceramic oxygen ion conductor, a porous anode in contact with the electrolyte membrane on the fuel side of the cell, and a porous cathode in contact the electrolyte membrane on the oxidant side of the cell. The anode is typically a ceramic-metal composite. The net electrochemical reaction involves charge transfer steps that occur at the interface between the ionically conductive electrolyte membrane, the electronically-conductive electrode and the vapor phase. The vapor phase involves fuel for the anode and oxygen for the cathode.

See Column 1, Lines 30-42. However, Wallin does not disclose the characteristics of the fuel used for the aforementioned solid oxide fuel cell. Fasano et al. teach the use of light hydrocarbons, such as methane, propane, ethanol and methanol, as fuel for a solid oxide fuel cell because they produce less carbonaceous material build-up in the anode. See Column 1, Lines 5-8, 61 to Column 2, Line 2. The typical sulfur content in the methanol is found to be between 1 to 5 ppm as documented in Yamauchi et al. See Column 45, Line 34; Column 58, Line 54. Therefore, it would have been obvious to one of ordinary skill in the art to use a light hydrocarbon fuel, such as methanol having sulfur content of 1 to 5 ppm, on the solid oxide fuel cell of Wallin, because Fasano et al. teach the use of a light hydrocarbon fuel can reduce the build-up of carbonaceous material in the anode of a solid oxide fuel cell.

With respect to claim 20, Wallin teaches process to generate electrical energy by using a solid oxide fuel cell, which comprises a electrolyte membrane of a ceramic oxygen ion conductor, a porous anode in contact with the electrolyte membrane on the fuel side of the cell, and a porous cathode in contact the electrolyte membrane on the oxidant side of the cell. The anode is typically a ceramic-metal composite. The net electrochemical reaction involves charge transfer steps that occur at the interface between the ionically conductive electrolyte membrane, the electronically-conductive electrode and the vapor phase. The vapor phase involves fuel for the anode and oxygen for the cathode. See Column 1, Lines 30-42.

However, Wallin does not disclose the characteristics of the fuel used for the aforementioned solid oxide fuel cell. Fasano et al. teach the use of light hydrocarbons, such as methane, propane, ethanol and methanol, as fuel for a solid oxide fuel cell because they produce

less carbonaceous material build-up in the anode. See Column 1, Lines 5-8, 61 to Column 2, Line 2. The typical sulfur content in the methanol is found to be between 1 to 5 ppm as documented in Yamauchi et al. See Column 45, Line 34; Column 58, Line 54. Therefore, it would have been obvious to one of ordinary skill in the art to use a light hydrocarbon fuel, such as methanol having a sulfur content of 1 to 5 ppm, on the process of Wallin, because Fasano et al. teach the use of a light hydrocarbon fuel can reduce the build-up of carbonaceous material in the anode of a solid oxide fuel cell.

Response to Arguments

5. Applicant's arguments filed on September 17, 2003 have been fully considered but they are not persuasive.

Applicant's principle arguments are

(a) Anumakonda reference describes another mechanism of reforming sulfur-containing fuels into hydrogen gas and carbon monoxide prior to feeding the hydrogen gas to a solid oxide fuel cell;

(b) none of the prior art disclose or suggests a solid oxide fuel cell capable of directly processing , without reformation prior to introduction into the fuel cell, a sulfur-containing hydrocarbon fuel;

(c) methanol typically does not contain sulfur in amounts above 0.5 pm as indicated in the Yamauchi reference. In contrast, the sulfur content of commercially available methanol for use in fuel cells is at most about 0.5 ppm;

(d) Fasano recognizes a problem with some heavier fuels, but in no way suggests that light hydrocarbon fuels somehow "reduce the build-up of carbonaceous materials".

In response to Applicant's arguments, please consider the following comments.

(a) The recitation of "a solid oxide fuel cell comprising" in claim 1 is an open language, which could include additional processing limitations;

(b) the recited novelty is not included in the independent claims;

(c) Applicant has not submitted any supporting document to substantiate the alleged claim;

(d) Fasano et al. teach that heavier fuel, such as jet fuel and kerosene, can be used, but in some cases the internal reforming is not efficient enough to reform the fuel and carbonaceous material is built up in the anode. Instead, light hydrocarbons, such as methane, propane, ethanol and methanol, are used as fuel on the solid oxide fuel cell of Wallin to alleviate the problem.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after

the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dah-Wei D. Yuan whose telephone number is (703) 308-0766. The examiner can normally be reached on Monday-Friday (8:00-5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan, can be reached on (703) 308-2383. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Dah-Wei D. Yuan
October 31, 2003

Patrick Ryan
Supervisory Patent Examiner
Technology Center 1700